enerSave
For Municipalities

Municipal Energy Savings - Case Studies

Energy, Mines and Resources Canada
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Appendix

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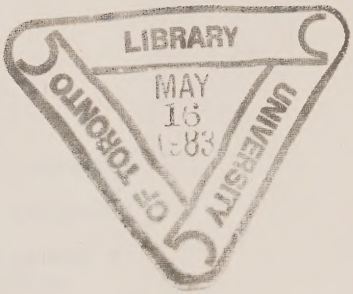

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Municipal Energy Savings - Case Studies

Introduction

Energy conservation has already become an issue in many Canadian municipalities. Energy management programs have been introduced, and so have a wide variety of projects which are now resulting in important energy savings.

It is to share some of this growing experience that the case studies in this section have been included. Although only a few projects are discussed, these examples clearly suggest that savings are possible when the necessary commitment and determination exist.

In some of these projects, energy conservation was an unplanned benefit of efforts to meet other objectives. In other cases, a desire to reduce energy consumption was the reason for the project in the first place. In all cases, however, the experience and information which has resulted can be invaluable to municipalities considering similar measures in their own communities.

Case studies, however, are not models, and none of the projects described here is directly transferable. Some have been possible only because of circumstances peculiar to the community itself. Perhaps the most important insight these experiences offer is that each community has its own unique opportunities to reduce its energy consumption.

These case studies were originally published in a study done for the Ministry of State for Urban Affairs, and have been revised and updated for this publication.* Each gives a brief project description, including details of management and financing where useful. Formal objectives are defined for each project, and some indication is given of how well it has succeeded.

Recurring problems are identified, as well as those factors which were particularly important for the success of the venture. Each case study also includes a contact name as a source of further information.

1- Energy Conservation in Oromocto, N.B.

Designed as a model town in the mid 50's, Oromocto today maintains that heritage of careful planning with one of the most comprehensive energy conservation programs in the country.

Conservation became a serious issue in Oromocto in 1977. By March of that year, rising energy prices and heavy reliance on imported oil had led the Town Council to introduce determined measures to cut back municipal energy use. Once a committee was established, immediate steps were taken to increase community awareness of conservation and to introduce low-cost modifications to municipal operations. Activity has since expanded on both fronts, and the program today is considered extremely successful by municipal officials.

Program objectives

- To set an example by cutting back on energy use
- To create an awareness of the importance of conserving energy by involving the whole community in the conservation program
- To encourage responsible planning within departments in the town
- To help secure an energy efficient future by decreasing Oromocto's reliance upon oil
- To save taxpayers money

* Gibson, Judith. Local Energy Initiatives in Canadian Urban Settlements. CMHC March 1979. Adapted with the permission of Canada Mortgage and Housing Corporation.

Program description

In-house projects undertaken to date include:

- re-insulation of Town Hall from R-7 to R-28;
- installing insulation in Fire and Police buildings;
- changing from incandescent and mercury vapor lights to fluorescent lights in all town buildings;
- installing storm windows on Fire Hall and Police and Works Department buildings as well as Town Hall;
- moving street light standards 300 feet apart in new subdivisions rather than the previous 200 feet, and lowering the wattage demand per pole;
- removing the heat (electricity or oil) from six outdoor rink shacks;
- turning thermostats down to 20 maximum in all town-owned buildings. (This setting is adjusted downward depending on how the building is used);
- removing the infrared heaters from the town arena. The greatest single saving, this one item saved about $4,000 in the first year;
- introducing a fleet replacement policy specifying purchase of small cars only;
- installing zone valves with thermostats in Town Hall;
- installing seven-day skipper timers on eleven hot water tanks within town buildings. (Suggestion made to the Awards Committee);
- operating two wood stoves to supplement oil heating in the Works garage and Fire Hall. These units have both been paid for by savings on oil of over $2000 during the first winter of operation;
- installing a wood fired hot water boiler rated at 200,000 BTUs in the Works Department office building workshop;
- controlling tennis court lighting to the extent that there must be a minimum of six players on the courts before the lights are turned on.

Along with their internal conservation program, the Energy Conservation Committee has initiated and supported numerous community projects:

- an energy program at the local shopping malls for February Energy Conservation Week;
- co-sponsoring, along with the town's merchants and Gagetown Army Base, a poster, essay and colouring contest in town schools (the motto "Waste now - Want later" was also chosen through a contest involving community and schools);
- arranging for Boy Scouts to deliver pamphlets and booklets on energy to all homes in Oromocto;
- sponsoring a community Zero Energy Day and a competition with another town (Kapuskasing, Ontario);
- recycling paper, a program in effect for the past two years and run by voluntary community groups as a money raising project;
- giving out, with each building permit, a pamphlet outlining energy savings in building structure and materials. This pamphlet entitled "Building Tips" includes information on such topics as choosing a site, house design for energy efficiency, insulating, heating, lighting, and landscaping;
- workshops on energy conservation held for all teachers, with manuals on appropriate presentations and teaching methods distributed during the sessions.

Staff participation has been an important factor in the program's success. Well represented on the committee, municipal staff have been the source of many suggestions. Early in 1979, Council introduced an Awards System, offering cash bonuses for effective energy conserving ideas. In 1979, a total of $1,050.00 was awarded to eight individuals.

Committee members are now looking into expanding wood burning in municipal buildings, district heating, passive solar heating, peak energy demand, the building code and by-laws, street lighting and municipal sponsorship of a Community College course on conservation.

Program management

The energy conservation program is under the direction of the Oromocto Energy Conservation Committee, set up by Town Council in 1977. It is responsible for program development and implementation, and reports to Council.

The committee was structured to include representatives from each of the town's departments (four members from Works Department, four members from Fire Department, three members from Leisure Services Department, one member from Police Department, one member from Library, the Town Clerk and one Town Councillor).

The structure is important. Council reasoned that to legislate changes in municipal buildings and transportation fleet, the people dealing with the changes should be consulted at the planning stage and be advised of the reasoning behind decisions. Had Council formed a committee of department heads and senior personnel, much more work would have been required to sell the program. As it is, most ideas and suggestions for change have come from committee members who work directly with town machinery and buildings.

An Energy Conservation Officer, recently appointed, keeps the committee abreast of new energy saving ideas and collects data on energy savings. This is a part-time position at present, for three afternoons a week during a six-month period.

An additional committee has been formed to deal with energy and economy. Called SEE for Safety, Energy and Economy, this committee was a natural outgrowth of the Safety Committee already in operation. It is working well and is considered very useful.

A final element, a Community Energy Conservation Committee, is now in the planning stage. The committee roster will include representatives from local merchants, the Hospital, Base Gagetown, School Board, local industry, as well as private citizens.

As for program monitoring, the Committee maintains charts of monthly energy use in all buildings. Information on energy goes back three years, and the charts are visible proof to those working in various buildings that their efforts in conserving energy are working. Committee officials consider this kind of direct encouragement essential. At present data is drawn from electricity and fuel bills. The committee is now working at developing a more complete information collection system.

Financing

The town budgets for major items such as new storm windows and doors, ceiling fans and wood stoves. However most funds come from the maintenance budget and Council approves each item separately. Most projects have a very short pay-back period (e.g. less than one season for installing wood stoves) and projects are generally limited to a maximum five-year pay-back period.

Program achievements

The program is meeting many of its objectives and it is considered extremely successful by municipal officials. There has been a noticeable decline in energy consumption, which is the clearest indicator.

In 1978, electricity consumption decreased by 116,000 kwh, enough to meet the annual needs of Town Hall, the Community Centre, and Works Department garage and offices. In 1979, there was a further decrease of 80,071 kwh used in all Town buildings. Some areas experienced greater savings than others. For example, the Works Department garage had the greatest saving in fuel and electricity in 1979.

Works Dept. Garage	Electricity Used (kwh)	Fuel (litres)
1 Jan.-31 Dec. 1978	53,966	42,816
1 Jan.-31 Dec. 1979	38,700 5,266	29,595 3,220
	(28% decrease)	(31% decrease)

The 31% decrease in fuel use is attributed to the wood stove installed to supplement the heating system.

There are many less tangible indications of success as well. No public complaints have been received over more visible cutbacks such as arena heaters, and there is considerable public involvement in

conservation activities. The schools are becoming more active; in 1980 more than 900 entries were received in the colouring poster and essay contests, an increase of approximately 200 entries over the previous two years.

The town has also been in competition with Kapuskasing, Ontario. During a 'Zero Energy Day' program citizens were encouraged to cut back on energy use. Businesses were actively involved, and the New Brunswick Electric Power Commission monitored energy consumption in Oromocto for the day. Oromocto won the competition with a 14% saving. Local merchants are getting involved in conservation activities in other ways and this year awarded prizes for energy conservation week contests. They also hold energy week specials in their stores.

The Oromocto Public Hospital has achieved significant energy savings in the past three years. The local School Board has also formed a committee to investigate energy conservation.

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"Oromocto Energy
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2- Energy Management in Mississauga, Ontario

Successful on many counts, Mississauga's energy conservation program is particularly noteworthy for its energy monitoring system. After one year's effort the City has surpassed its targeted 10% reduction in energy consumption, and is now expanding activities to include greater community involvement.

Officials identify four factors which are particularly important in their program: the commitment of senior officials, a committee with authority to act, an effective system for measuring energy consumption levels, and staff with time to devote to planning and coordinating conservation activities.

Program objectives

- To reduce energy consumption by 20% over the base year in this second year of the program (1980)
- To develop an effective method of measuring savings and assessing program effectiveness

Program description

Mississauga's system for monitoring energy consumption is a particularly important factor in its conservation program. As the Committee saw its mandate, its first step was to ensure that energy savings could be measured: the Purchasing Department collected 1977/78 energy data for municipal buildings, averaging out electricity, gas, oil and water consumption to establish a base measure of energy use (in common units and in dollars) for city-owned buildings and facilities. Although only 55 of the City's 175 buildings and facilities have been measured so far, these account for 85% of energy used in municipal buildings. By the end of 1980, 114 were measured.

The Purchasing Department is responsible for recording consumption data on a continuing basis, with monthly reports to the energy coordinator. He in turn reports quarterly to each department head, comparing figures to the base data and including cost calculations based on current rates. A summary report is sent to the City Manager, who reports to Council.

In a program where each department Head is responsible for conservation activities within his/her own department, the monitoring system provides a strong incentive and cohesion to conservation activities. It also ensures that unusual increases in energy consumption are caught early. Wherever consumption levels are high compared to the base, figures are discussed with departmental officials.

When changes occur in the energy needs within a facility, careful adjustment of the base figure becomes necessary. Procedures are now being developed to ensure that such adjustments are, and are seen to be, impartial.

Inconsistencies and errors in available data have created some difficulty with data collection. Although not a serious problem, inaccurate figures have led city officials to revise their accounting procedures. In some cases city staff is doing its own readings. Data collection forms developed by the City are considered exceptionally effective, and have already been used as a model elsewhere.

Effective as it is, however, the monitoring system is only a way of measuring energy savings. Mississauga has introduced a variety of internal measures to achieve these savings.

Changes in operating procedures have proven particularly effective. Within general guidelines issued by the committee each department develops and runs its own program. The program in City Hall, for instance, involved the following:

- shutting off air conditioners during unoccupied hours
- reduced humidification
- shutting off cooling power when unnecessary
- heat control by means of water temperature in heating system (there were too many thermostats for effective control)
- relamping, reducing wattage as replacement is required
- turning off fans and heat coil (Data indicated that radiators on the building perimeter were sufficient.) This alone reduced gas consumption by one third on weekends
- an improved maintenance schedule to ensure top performance and avoid breakdown

High pressure sodium lamps are being installed for all new street lighting. In addition a relamping program has been introduced to convert the city's existing street lighting. Since 1978, approximately 400 lamps have been changed for a saving of approximately $10,000 per year (1979 prices).

The City's motor fleet has been another focus of conservation efforts: energy conserving measures include improved maintenance, smaller vehicles, a switch to diesel for buses and large trucks, operating guidelines for drivers. In addition, a computer program monitors performance and operating costs (miles per gallon/cost per gallon) and unusual data is flagged for investigation.

A publicity program is also being developed to keep the City's conservation concerns in the forefront for employees as well as the public: posters, press releases, items for local newsletters and promotional material will all be used to publicize both conservation issues and municipal conservation activities.

Finally, and perhaps the most far-reaching energy initiative to date, an energy study has been commissioned to analyze energy consumption characteristics of the City Centre plan and identify ways of ensuring efficient energy use while remaining consistent with the Plan's objectives.

Program management

Representatives from each municipal department sit on the Mississauga Energy Conservation Committee. Originally comprised of heads of departments, the Committee today consists largely of departmental delegates now that conservation activities are well underway. Attendees vary according to the needs of the agenda, but every department in the municipality continues to be represented. The committee reports through its chairman to the City Manager.

An Energy Conservation Coordinator, hired in mid-1979, is responsible for coordinating conservation activities, providing advice and technical assistance to the departments, and for all aspects of preventive maintenance in Buildings.

Within general guidelines established by the committee each department is responsible for developing and carrying out its own conservation program.

Financing

Up to this point no money has been allocated specifically for conservation measures in buildings. Some activities - improved maintenance, for instance - involve increased costs, but these are covered by existing budgets. The other exception is the street lighting relamping program: the City makes approximately $40,000 available

per year in its capital budget for lamp replacement. At this point the pay-back period on investment is approximately four years.

Officials feel that municipal operations are now approaching optimum efficiency and that to achieve further savings financial investment will be necessary.

Program achievements

Working towards a targeted 10% reduction in energy consumption over the first year of the program, City officials in fact achieved energy savings of 11.4% (and 10.5% in water consumption). In dollar terms, savings amounted to $91,910 over what would have been required at 1977/78 consumption levels to operate buildings. For City Hall, the most important single source of savings, 38.3% less energy was consumed and 49.1% less water.

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3- Energy Economies in Quebec's Motor Vehicle Fleet

Conscious that energy savings could help to rationalize municipal expenses, Quebec City sector heads established an unofficial energy conservation committee in 1976. Committee members succeeded in convincing their managers and elected representatives of the importance of conservation, and two years later the Quebec City Executive Committee created an official Energy Conservation Committee. Sitting on that Committee are the Mayor and representatives of the Public Works Department, Public Roads Department, Traffic Department and Planning Department. The Committee formulates recommendations to the Executive Committee, in co-operation with the municipal departments concerned.

Apart from its work with the municipal vehicle fleet, the Committee has also introduced conservation measures in municipal buildings and in lighting systems. The energy implications of urban development are also being reviewed.

Program objectives

To reduce operating and maintenance costs for the municipal vehicle fleet by reducing fuel consumption, increasing the useful life of fleet vehicles, and maintaining and improving their operating efficiency.

Program description

The Quebec City vehicle fleet operates 500 units, including 200 heavy vehicles, 100 police cars, 75 panel trucks, 40 light vans and 12 parking attendants' cars.

The fleet conservation program began in 1973, and has intensified since 1978. There are five aspects to the program: turning off engines, converting to diesel for heavy vehicles, replacing light vehicles with smaller models, rationalizing routes and controlling fuel consumption.

1. Turning off the engine in unoccupied vehicles

The Committee's concern here has been to ensure that the engine is turned off when there is no one in the vehicle.

A directive was issued by the City Manager stating that the engine of an unoccupied vehicle cannot be left running unless it is necessary for the operation in progress. To reduce any need to leave the engine running when the vehicle is stopped, certain vehicles have been equipped with larger batteries so that the radio and flashers may operate up to half an hour after the engine has been turned off.

By way of enforcement, the key is removed from vehicles in default. The person responsible for the car must recover the key from his superior. If the infraction is repeated, he must go to the department head to recover the key, then to the Manager and finally to the Mayor.

In addition, training sessions are given to heavy vehicle operators and to drivers of all vehicles, stressing driving methods which are easy on the engine. Energy conserving driving is also emphasized, and instructors stress that the engine must be stopped when the driver leaves the vehicle.

2. Switching to diesel for heavy vehicles

Conversion to diesel began in 1973, and 90% of the fleet's 200 heavy vehicles (over ten tons) are now of this type.

A 30% to 40% reduction in fuel consumption, as advertised by the manufacturers, was achieved, offset only by the higher acquisition cost involved. Advantages of the diesel engine include:

- 30 to 40% reduction in fuel consumption
- reduction in the number of breakdowns due to snow: in a snowstorm, a third of the gasoline-powered vehicles may break down (this is also important for fire trucks)
- reduction in maintenance
- increase of one year or more in the useful life of each vehicle

At present the City is equipping as many sweepers, snow-clearing tractors and intermediate-capacity vehicles as possible with diesel motors.

3. Switching to lighter and less powerful vehicles

Police cars - 22 of the City's 100 police cars have just been replaced. Previously, all police cars were full-size models with 350-cubic-inch engines. The 22 new cars are intermediate models with 300-cubic-inch engines. Prototypes tested last year proved to be very acceptable.

The advantages of changing from full-size to intermediate-size models and adopting a 300-cubic-inch engine instead of a 350-cubic-inch engine include:

- better acceleration
- lower purchase cost (by $400)
- a reduction in gas consumption of 0.6 litres/100km

Small panel trucks - The fleet includes 75 panel trucks. Until recently, 3/4-ton panel trucks were purchased systematically. A few light panel trucks have proven satisfactory, however, and the last replacement purchase substituted 16 small panel trucks for 3/4-ton panel trucks. No user was able to justify a 3/4-ton vehicle. The new acquisitions have 2.2-litre engines and gasoline consumption has been reduced by nearly half, from 18 litres/100 km to 10 litres/100 km.

4. Rationalization of routes

A study of the garbage collection routes in 1977/78 resulted in the City reducing the number of trucks from 23 to 17, with a saving in gas and a corresponding saving in manpower. A study of the sweeper routes is now being carried out.

5. Maintenance and control of fuel consumption

A fuel consumption control system has just been set up. Each vehicle will have a file card, making it possible to examine its gasoline consumption and to intervene to save fuel.

Vehicles will now be called in for maintenance on the basis of fuel consumption. The number of kilometres travelled is not representative, as the vehicles are very often stopped. The other alternative, counting the hours of operation, is tedious.

The purpose of the improved maintenance system is to extend the useful life of the vehicle, and reducing fuel consumption is a secondary consideration.

Program management and financing

Management and financing of the fleet conservation program are integrated into normal municipal operations. The Chief of the Equipment Division is responsible for the cost effectiveness of municipal operations and for energy conservation, and manages the vehicle fleet accordingly. He is supported by the Manager and the Executive Committee, and by the Energy Conservation Committee.

A third committee, the Equipment Committee decides how the annual vehicle acquisition budget of $2,000,000 will be allocated.

It was this committee which established the policy of purchasing smaller and less powerful vehicles. Its main objective is to rationalize the composition and use of the vehicle fleet to reduce costs. Energy conservation is a secondary objective, but a logical and important one.

1. Turning off the engines of unoccupied vehicles.

The program is based on a managerial directive. The cost is absorbed by ordinary operations, even in the few cases where the program has resulted in the replacement of batteries.

2. Switching to diesel

This is a policy supported by the Manager, the Energy Conservation Committee and the Equipment Committee. The power of the equipment and engine must be justified by real need. It is the ordinary budget which finances this operation, the cost effectiveness of which is recognized (a third of the fuel saved) without exact figures being broken out in each case.

3. Replacement with smaller vehicles

The success with the police cars was made possible by prior testing of a prototype. The policy of reducing the size of the vehicle, the power of the engine and the number of cylinders is promoted by the Manager, the Equipment Committee and the Energy Conservation Committee.

A vehicle user must prove to the Chief of the Equipment Division and to the Manager that he needs a larger vehicle. To date, no user has been able to furnish such evidence. Sixteen panel trucks have been replaced so far, and 12 sub-compact cars purchased for the parking patrol.

4. Study of routes

This cost-effective project was set up and implemented within the normal functioning of municipal services. The number of compacting garbage trucks was reduced from 28 to 18 by rationalizing the routes.

5. Control of fuel consumption

Once again this project was implemented within the framework of normal City of Quebec management. It is to the City's economic advantage to monitor fuel distribution, to establish a more rational vehicle maintenance schedule and to have data on each vehicle's fuel consumption.

Program achievements

Over the last three years the City of Quebec's fuel consumption has remained constant at 3,000,000 litres a year, despite a 7.5% increase in the number of vehicles.

Forecasts indicate that consumption will decrease in the future. The replacement of the police cars and panel trucks with smaller vehicles is a step in that direction.

Insisting that engines be turned off when vehicles are not occupied has been an effective measure. We no longer see municipal vehicles stopped with the engines running when the employees are elsewhere.

Rationalizing the size and use of the vehicle fleet reduced vehicle rental costs to 2 million in 1979 from 3 or 4 million dollars per year.

The 22 intermediate police cars travel 30,000 km per year and save 0.6 litre/100 km each as compared with a large car. The 22 cars therefore save 4,000 litres per year.

The 16 panel trucks with 2.2-litre engines purchased to replace 3/4-ton trucks travel 25,000 km/year. They consumed 10 litres/100 km rather than 18 litres/100 km. They therefore saved 32,000 litres per year.

The system to monitor fuel consumption was introduced too recently for results to be available.

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4- Electric Load Management at Guelph Hydro

Program objective

To contain and reduce the cost of electric power to the public through a reduction in the utility's demand purchasing from Ontario Hydro.

Program description

A central computerized system monitoring the amount of power purchased from Ontario Hydro provides projections which indicate any possibility of setting new peak demand. At this point the utility turns off residential electric water heaters by means of a pilot wire system, which includes a controllable relay in each unit.

The pilot wire system, which is a key element in the program, was already installed and in operation. This greatly facilitated implementation of the system.

Planning for the program began in the fall of 1976, and it was first implemented in June 1977. The utility is also interested in expanding the program to various types of industries. The main problem to be resolved is what type of compensation will be given to an industry for shedding its load at municipal peak times.

The utility itself developed and built much of the necessary electronic equipment to reduce costs. The system is currently being upgraded with a new computer and reworked computer programs to increase flexibility.

Program management

The concept was developed internally by a senior management group composed of the General Manager, Administrator, Chief Engineer, Treasurer and Manager of Data Processing. The program was designed by the Data Processing Division, and its operation is supervised by the Manager of Data Processing. No outside consultants were used.

Financing

Expenditures by the utility amounted to $125,000 which includes the computer and related costs as well as development of special electronic equipment. No government money was received, nor was any exemption of duty or sales taxes granted on equipment purchased. Costs were paid with revenue from rates. The anticipated pay-back period is two years.

Program achievements

The annual load factor has improved from 70.1% (1977) to 70.4% (1978) to 71.4% (1979), increases attributed primarily to the pilot wire system.

Customers have definitely benefited: there were no rate increases between March 1977 and September 1979 despite annual wholesale rate increases from Ontario Hydro during that period.

There have been no customer complaints.

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5- Sludge Modification Using Recycled Newspaper, London, Ontario

London's new sludge modification process was designed to replace existing facilities which required extensive renovation. First proposed in 1976, initial upgrading was carried out during 1977-78. The facility became operational in September 1978 and Phase II of the project was completed in March 1980.

The new system is an improvement on several levels: it provides a stable market for recycled newspaper, reduces fuel consumption, and eliminates hazardous chemicals (i.e. ferric chloride and lime.)

The Greenway Pollution Control Centre serves approximately 150,000 people.

Program objectives

To reduce fuel costs for operation of the Pollution Control Centre and to eliminate use of hazardous chemicals.

Program description

Approximately 50 tons of newspaper a week, collected daily by a private contractor, are fed into pulpers at the Pollution Centre. The pulp is mixed with sewage sludge and polymers and then processed by four vacuum filters to extract moisture. The resulting filter cake, which is approximately 15% solid provides 20% of the fuel required by the gas-fired incinerators.

An important feature of the process is the replacement of ferric chloride and lime as a sludge conditioning agent with newspaper pulp and polymers added to modify vacuum filter cake as incinerator fuel.

Financing

A total capital cost of approximately $600,000 has been involved to date. Funds have been debentured from budget allocations for capital works. This figure is exclusive of engineering costs. Federal and provincial governments provided some financial assistance for the initial study.

Costs were incurred primarily for purchase and installation of equipment and for building construction, although some funds were spent to renovate and upgrade existing equipment. Phase II, involving removal of two vacuum filters, cost approximately $113,000 exclusive of engineering costs. The paper collection costs the city $37.50 per ton.

Program achievement

The system has resulted in a reduction in gas requirements, although exact figures are not available. With completion of Phase II, the replacement of vacuum filters by filter belt presses, the moisture content of the filter cake has been further reduced. A cut of 65% in gas demand is anticipated, a $250,000 saving per year at 1978 prices.

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6- Integrated District Heating in the City of Toronto

The Toronto district heating project benefited from early consensus by all parties that the existing system had to be integrated. In addition environmental problems created by the Pearl Street Plant demanded definite action to avoid infringement of environmental legislation.

The Toronto District Heating Study was commissioned in December 1969 and completed in December 1973. The plan for an integrated steam utility system was approved and authorized by City Council in October 1976. In August 1978 Council approved and executed a Memorandum of Intent with the participants. An operating utility, the Toronto District Heating Corporation, is currently being formed.

Construction of the integration phases involving the four existing steam plants began in June 1980 with completion scheduled for the fall of 1981.

Program objective

To rationalize existing district and group heating systems, with the eventual construction of a new base plant, thereby eliminating environmental pollution from the Toronto Hydro plant and conserving and utilizing available fuels more effectively than is possible by separate operations of the plants involved.

Program description

The district heating system will integrate four existing gas and oil-fuelled plants. A new partly refuse-fuelled base plant has been approved in principle by Council and the Toronto Hydro Pearl Street Plant, which is a source of severe environmental pollution, will be phased out when the new plant comes on stream. During the integration phase, it will continue to operate as a peaking plant. The integrated system will supply 82 subscribers (approximately 260 buildings) and will have a total steam send out capacity of 2 million lbs. per hour.

The capacity of the proposed base plant is tentatively estimated at 800,000 lbs. per hour, one quarter of which will be produced using refuse as fuel.

The completed system will integrate a district heating system (Toronto Hydro Electrical System) and three steam plants (Ministry of Government Services, Toronto Hospitals Steam Corporation and the University of Toronto).

Program management

It is proposed that the Toronto Hospitals Steam Corporation be reorganized as an operating utility. The University will enter into a trading agreement with the new utility until the new plant is operational while the Ministry will become a purchaser. The utility will assume responsibility as supplier for customers of Toronto Hydro District Steam Division and of the Toronto Hospitals Steam Corporation.

Financing

Estimated cost for integration of the systems is $12,160,000. Monies have been allocated in the City's Capital Budget (from 1977 to 1980) to finance the project and the City expects to recover fully its investment from steam revenue. The City has requested joint funding for design of the new base plant (Phase 2): City of Toronto, Metropolitan Toronto, Government of Ontario, Government of Canada, $500,000 each. The new plant is expected to cost approximately $70 million.

The operating utility will acquire, by purchase or lease, the assets of the district steam utility division of Toronto Hydro. On purchased assets, it will assume all current liabilities, contractual obligations and commitments as well as all funded debt attributable to those assets. Rent will be based on Toronto Hydro carrying charges on funded debt on the fixed assets as well as all taxes, service charges and insurance costs. The City will be guarantor of rental payments and assumption of debts and obligations. The University, as a trading partner, will sell steam in return for a contribution to its fixed costs. The Ministry's plant will also be acquired by

the operating utility and the Ministry will purchase steam at a cost equal to the cost of generating steam had it retained its plant.

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7- Relamping with Low Pressure Sodium - Metropolitan Toronto

Like many energy conservation initiatives Metropolitan Toronto's relamping program began with quite different objectives - to improve illumination levels on Metro expressways. Since the first experimental installation in 1969, reducing energy consumption has become a strong municipal priority, and Metro has achieved major energy savings by replacing streetlighting with more efficient low pressure sodium lamps.

An unexpectedly high lamp failure rate led the municipality to delay plans to complete relamping of the Gardner Expressway until technical problems were solved. Problems with premature burn-out of the LPS lamps were cleared up in 1979: adaptors were installed to change the angle of the luminaires from 15° above the horizontal to a horizontal position. The City is now resuming their planned relamping program, which will be carried out in 1980 and 1981.

Program objectives

To conserve energy by converting to more efficient lamps; to reduce the accident rate on Metro expressways by improving illumination.

Program description

In 1969 an experimental installation of low pressure sodium lighting on a 2.4 km section of the William Allen Expressway, in which 170 luminaires were installed to replace fluorescent lamps, resulted in a doubling of illumination with a reduction in power demand.

The 1975 installation of low-pressure sodium lamps on the 17 km of the Don Valley Parkway retained original poles, wiring and electronic equipment, and involved replacement of existing heads with new luminaires and lamps. Up to 150,000 cars per day use the parkway. The new system has increased the amount of light approximately 2.5 times (183 lumens per watt as compared to 80 per watt from the original fluorescent lighting), again with a reduction in power required.

In 1978, low pressure sodium lamps were installed on 3 km of the Gardner Expressway using different installation methods in an effort to reduce the number of lamp failures. It was also necessary to install poles on a 1-km stretch of the expressway, which increased overall project costs. After a delay to resolve technical problems, relamping of the remaining 11 km is now being resumed. Existing 400 watt fluorescent fixtures are being replaced with 135 watt LPS fixtures, for a reduction in power of about 42% of the original system. Additionally, improvements to the level of lighting will be significant.

Financing

In all cases, relamping has been funded out of Roads and Traffic Department capital funds. The Don Valley project involved 1,300 new lamps at a total cost of $350,000. The Gardner Expressway has involved an approximate cost to date of $57,000; in one section of the expressway, however, it was necessary to erect poles which added considerably to costs per unit installed (from $250 to $340 per unit). Completing the relamping of the Gardner will cost an estimated $260,000 for the 11 km involved.

Program achievements

In general, low pressure sodium lighting is considered superior to other types. It uses considerably less electricity, produces low glare, and is unaffected by cold weather. Unlike all other lighting types, it shows no

deterioration in illumination with age, and the monochromatic orange colour increases visual acuity.

In terms of the original objectives, the project has been successful. An 18-month survey of the William Allen Expressway after installation was completed indicated a 35% reduction in the number of night time accidents on that stretch of highway.

Power demand has been consistently less despite more than double the original illumination. The operation has saved 332,000 kwh in 1978 and 590,640 kwh in 1979. For every 1000 fixtures officials estimate that savings are about 244 kwh/year, or $27,000.00 per year.

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8- The City of Quebec Converts to High Pressure Sodium

Quebec City's program to purchase the Hydro-Quebec lighting system and to convert it to high pressure sodium is the first major program to be implemented by the City's energy conservation committee.

Project objectives

- To supply street lighting of adequate intensity at a lower cost
- To save electricity

Project description

This project involves the purchase of Hydro-Quebec's lighting system to reduce annual cost and to improve maintenance. To do this, the City is replacing incandescent lights, which make up half the lights of the system, because of their poor lighting performance and high power consumption.

At the time of the purchase from Hydro-Quebec, the street lighting system included:

3822 mercury vapour luminaires,
150 high pressure sodium luminaires,
2857 incandescent luminaires (1000 with 300W and 1857 with 500 W).
6829 luminaires

Work was carried out between January 15 and June 15, 1980.

The system now has:
3744 mercury vapour luminaires
150 150W high pressure sodium luminaires
1221 70W high pressure sodium luminaires
1871 100W high pressure sodium luminaires
6986 luminaires

The modifications included the elimination of 99 incandescent and 78 mercury vapour luminaires, and the installation of 412 high pressure sodium luminaires at new locations.

Project management

After a period of data collecting and an analysis of the cost and technical possibilities, the Electricity Division concluded that it was advantageous to purchase the Hydro-Quebec system, to replace incandescent lights with high pressure sodium lights and to maintain the lighting system under city control.

During one year, in 1977/78, Hydro-Quebec successfully tested 150 high pressure sodium luminaires on behalf of the City of Quebec.

This project was reviewed by the City managers and by the Energy Conservation Committee, and was recommended by them to the Executive Committee, which approved it. A borrowing by-law was passed by the Council to finance the operation.

The system was purchased from Hydro-Quebec under three contracts in December 1979:

- contract to purchase the system
- contract for power supply, wiring and space leased on the poles
- maintenance and installation contract.

A residential-type luminaire was designed by the City of Quebec and was produced and marketed by a local firm. The work was carried out by Hydro-Quebec between January

15 and June 15, 1980.

At present it is not economical to substitute high pressure sodium luminaires for the mercury vapour luminaires, which are in good condition. The investment cost for this change is $280 per luminaire, and removing a 250W mercury vapour luminaire to replace it with a 100W high pressure sodium luminaire results in a saving of only $25.51 in electricity (100W, 4200 hours/year, $0.0375 per kWh at the 1980 street lighting rate). The simple pay-back period is 11 years.

Instead, the City plans to replace burned out mercury vapour luminaires with high pressure sodium luminaires once their stock of mercury vapour luminaires is exhausted.

This is seen as an interim measure until the price of electricity rises sufficiently and the price of the high pressure sodium luminaires decreases sufficiently for the change to be economical.

Financing

A loan of $1,700,000 financed the operation. The expenses are distributed as follows:

-purchase of the Hydro-Quebec system	$895,000
-lineman crane truck and equipment	102,500
-purchase of lights, hangers, fixtures, attachments, wiring, parts	443,300
-installation by Hydro-Quebec	120,000
-miscellaneous expenses	2,000
-reserve for additional lighting	137,200
TOTAL	$1,700,000

Before acquiring and modifying the system, the City of Quebec was paying $950,000 to Hydro-Quebec for lighting.

Today the cost of lighting the streets amounts to:

-power supply, rental of wiring and space on the Hydro-Quebec poles	$337,000
-interest and repayment of loan, additional personnel, inventory, maintenance expenses	220,000 to * 260,000
TOTAL	$ 537,000 to $ 597,000

This results in an annual budgetary saving in the order of $350,000 to $400,000, or approximately 40% when compared with $950,000.

Program achievements

The municipal administration, the managers and the project administrators are all satisfied, and the city has also received letters of congratulations from citizens.

The street lighting will cost $350,000 to $400,000 less in 1980, 40% less.

Despite the addition of luminaires and the increase in the level of lighting the reduction in power consumption at the 1980 price is as follows:

-reduction in demand:	900kW or 23%, from 3,900kW to 3,000kW;
-reduction in annual consumption:	3,780MWh or 23%, (at 4200 hours year), from 16,380MWh to 12,600MWh;
-reduction in the cost of electricity:	$134,000 per year or 23% at 0.0375 per kWh (1980 street lighting rate);

In addition, the operation confers the following advantages:

- improvement of the lighting and a 45% increase in the level of lighting, where there had been incandescent lights
- a 60 to 75% reduction in power consumption, depending on the light source replaced, where there had been incandescent lights
- improvement of maintenance conditions
- elimination of tax payments on invoices from Hydro-Quebec for the provision of street lighting
- protection from a part of the increase in the cost of lighting because the capitalization and maintenance costs are under the control of the city
- less effect in future from increases in power rates because consumption has decreased by 23%.

To summarize, the City of Quebec has increased its level of street lighting, reduced its power consumption by 23%, and

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* Depending on the number of lights to be replaced and the price of sodium lights.

reduced its lighting expenditures by 40%.

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9- "Solar West" - Energy Conserving Development in Vancouver's Champlain Heights

As part of its focus on Conserver Society issues, the Vancouver City Council decided in 1977 to create a residential energy conservation demonstration project. The Champlain Heights area was being developed by the City, and one of the 21 land parcels, Enclave 2, was selected as a model. Start-up funds were allocated in February 1978 and the energy report was submitted in June 1979.

Builders will be selling - and confronting - life-style attitudes, and success of the project hinges on the responsiveness both of developers/builders and of the buying public. Flexibility has been essential in the project, as is often the case with such essentially unproven ventures, and it is recognized that developers cannot be expected to assume all the risk. In development, the City must play a facilitating as well as a controlling role.

Project objectives

To develop a residential energy conservation demonstration project within current market parameters.

Project description

The Champlain Heights development is designed as a mixed, family-oriented community incorporating assisted public and private housing and a range of community services (e.g. community centre, school and parks.) Enclave 2 will consist of 94 townhouses for market sale on an 11 acre site. The project is being conducted in two phases: research into various conservation techniques and their application to Champlain Heights; and actual development of the site.

Under Phase I, a Vancouver energy consultant carried out the necessary research, producing a "Conserver Primer" on energy conservation in relation to the new development. The primer was published in June 1979 and was intended to stand on its own as an independent contribution to available literature on the subject. It is now out of print. It addressed conservation considerations ranging from site planning to design and building techniques, including the potential for solar collectors and district heating.

The primer provides the basis for actual development in Phase II. The initial development call specified that proposals must take energy conservation into account. Developers must defend plans and design proposals in terms of the energy conservation criteria. Where the proposal does not comply to specifications, alternative measures must be incorporated that achieve the same conserving effect.

Phase II is currently in the construction stage. Most of the homes will be pre-sold, offering a selection of house designs to the buyer, and these designs will include energy conservation options, as well as upgraded specifications (e.g. increased insulation and site orientation.)

Project management

The Champlain Heights Development Group was established in 1976 to develop the land according to the guidelines adopted in 1974, reporting directly to the City Manager and

City Council. The Development Group negotiates on the developer's behalf with all other agencies and government departments, and supervises implementation of the development plan.

A consortium of four builders is developing the site in conjunction with HUDAC.

Financing

The City of Vancouver provided $10,000 and $20,000 was contributed by the Federation of Canadian Municipalities to underwrite costs associated with Phase I of the project.

The development option and land is being made available to developers on a 99-year lease, with standard financing arrangements.

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10- Fermont, Quebec - Energy Conservation in Community Design

Fermont, a northern resource town, was designed with particular sensitivity to adverse climatic conditions as well as to the social-economic problems of northern communities. Design development began in late 1969. Construction was completed in the fall of 1975.

Although the underlying design objective was to minimize discomfort to residents, many of the planning and design features directly affect levels of energy consumption in the community. No formal evaluation has been made of their impact, however, and no energy data is available.

Project objectives

To build a new resource community designed to minimize the effect of severe climatic conditions on inhabitants and on town operations.

Project description

Site selection was of fundamental importance in the design for Fermont, in terms of sunshine and radiation, wind frequency distributions, and the combined effects of wind and temperature.

Energy conserving features include:

- compact design, including higher densities (26.3 people/acre) and cluster housing built in sheltered areas to reduce wind velocity and provide each other with mutual protection. This also results in considerable savings in municipal services, as well as shorter walking and driving distances.
- a windscreen apartment building, concentrating the town's educational, shopping and recreational facilities in its base, shelters two-thirds of the townsite, including the most densely populated of the residential areas. Designed to reduce wind velocity, the windscreen has also affected micro-climatic conditions within its shadow, producing a slight increase in temperature and humidity.
- use of tree belts to shelter residential areas outside the wind shadow of the apartment building.
- southerly orientation for living areas of all accommodation, including apartment units in the windscreen building.
- a climate controlled mall linking all community facilities, resulting in a smaller street network and reduced use of cars.
- use of mudrooms to act as air locks between indoors and outdoors.

Project management

Construction was carried out by a consortium contracted by Quebec Cartier Mining Company, the sponsoring firm who supervised implementation of the master design. The architectural firm responsible for the original design was rehired by the consortium to develop detailed designs, but was not responsible for design control.

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